Hall C SHMS: Drift Chambers

Hall C Collaboration Meeting

August 6, 2008

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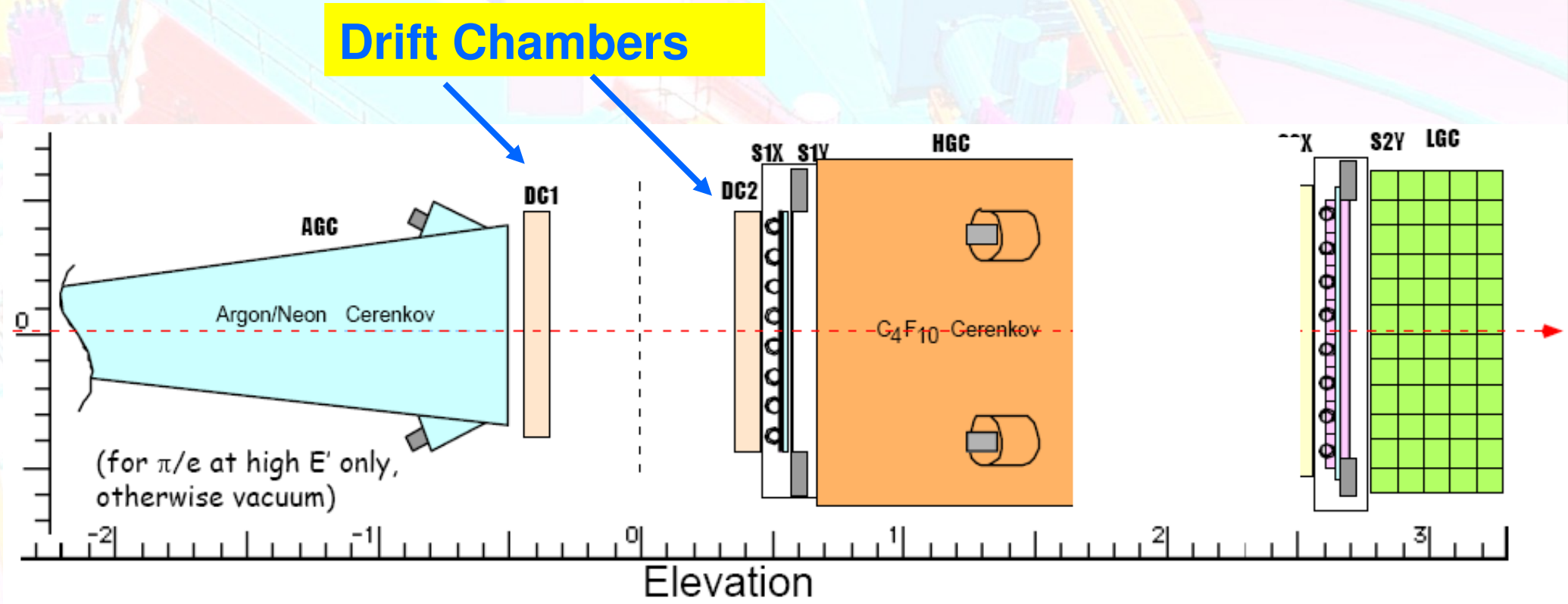
Hampton University



Overview

- Specifications & Scope of system
- Conceptual Design
- Schedule
- Summary

Specifications

1) resolution: in-plane angle: 2-4 mrad
out-of-plane angle: 1-2 mrad
momentum: < 0.2% (~200 μm / plane meets these)

2) rates: Up to 5 MHz

3) envelope: 1m (in plane) x 0.9m (out of plane)

Impact on Design

1) resolution => cell width, # of planes, etc.

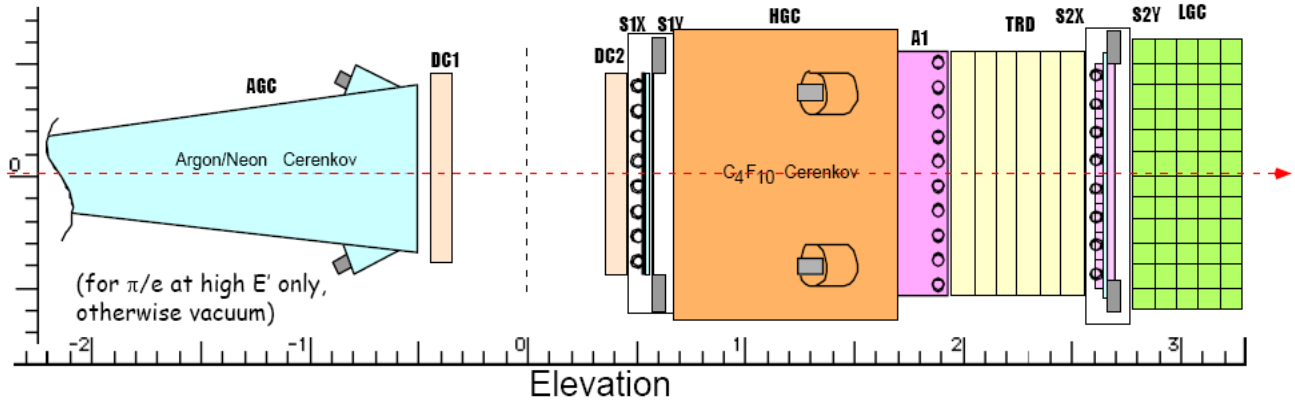
2) rates => cathode / window materials / gas

3) particle envelope => active area

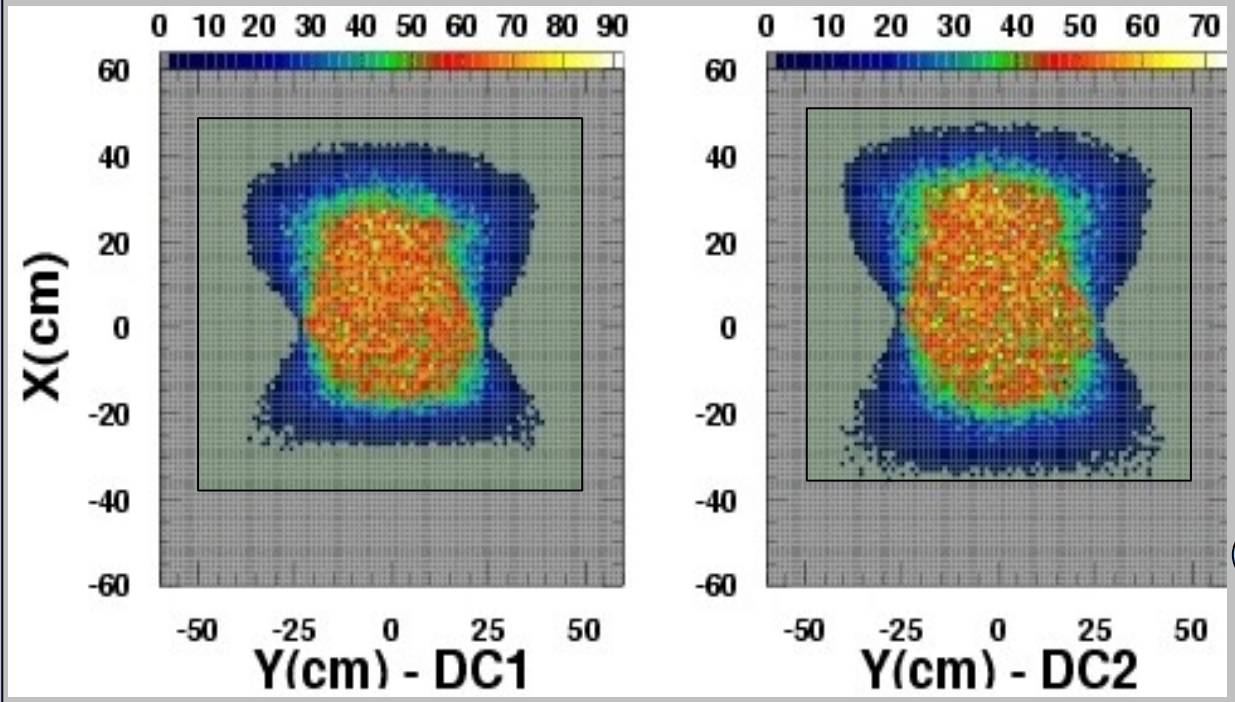
HKS chambers built by HU shown to meet 1) and 2)

Design based on successful SOS chambers built by BNL group (D. Sutter, B. Chien)

DC Dimensions



Envelope at DCs



Detector	Z(cm)	X(cm)	Y(cm)
DC1	-40	(-30,+45)	(-45,+45)
DC2	+40	(-35,+45)	(-50,+50)
S1	+55	(-35,+50)	(-50,+50)
Cerenkov	+160	(-40,+55)	(-55,+55)
S2	+265	(-50,+60)	(-65,+60)
Calorimeter	+320	(-50,+65)	(-65,+65)

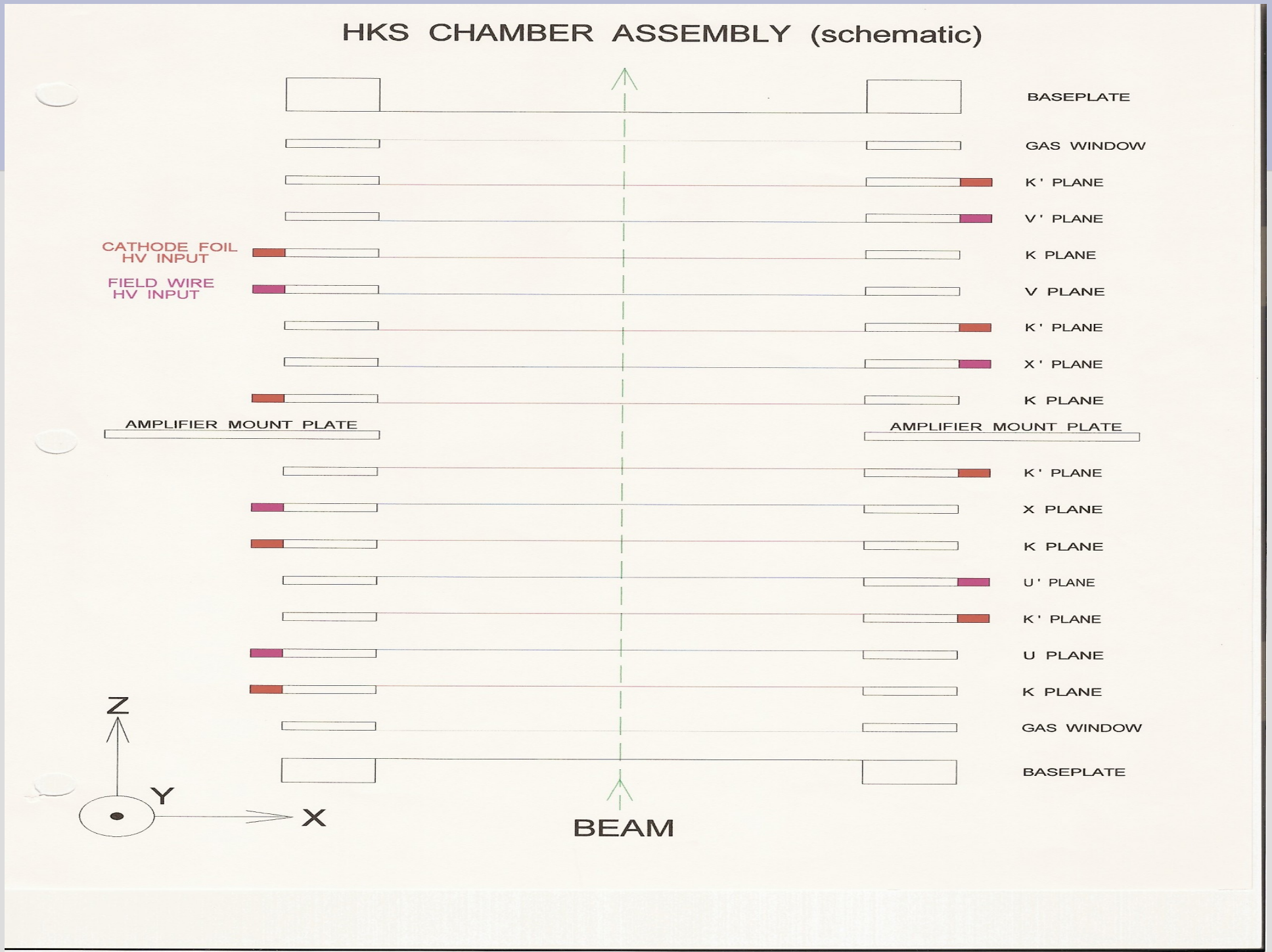
Active Area:
90cm (X), 100cm (Y)

Conceptual Design
(HKS design will be shown)

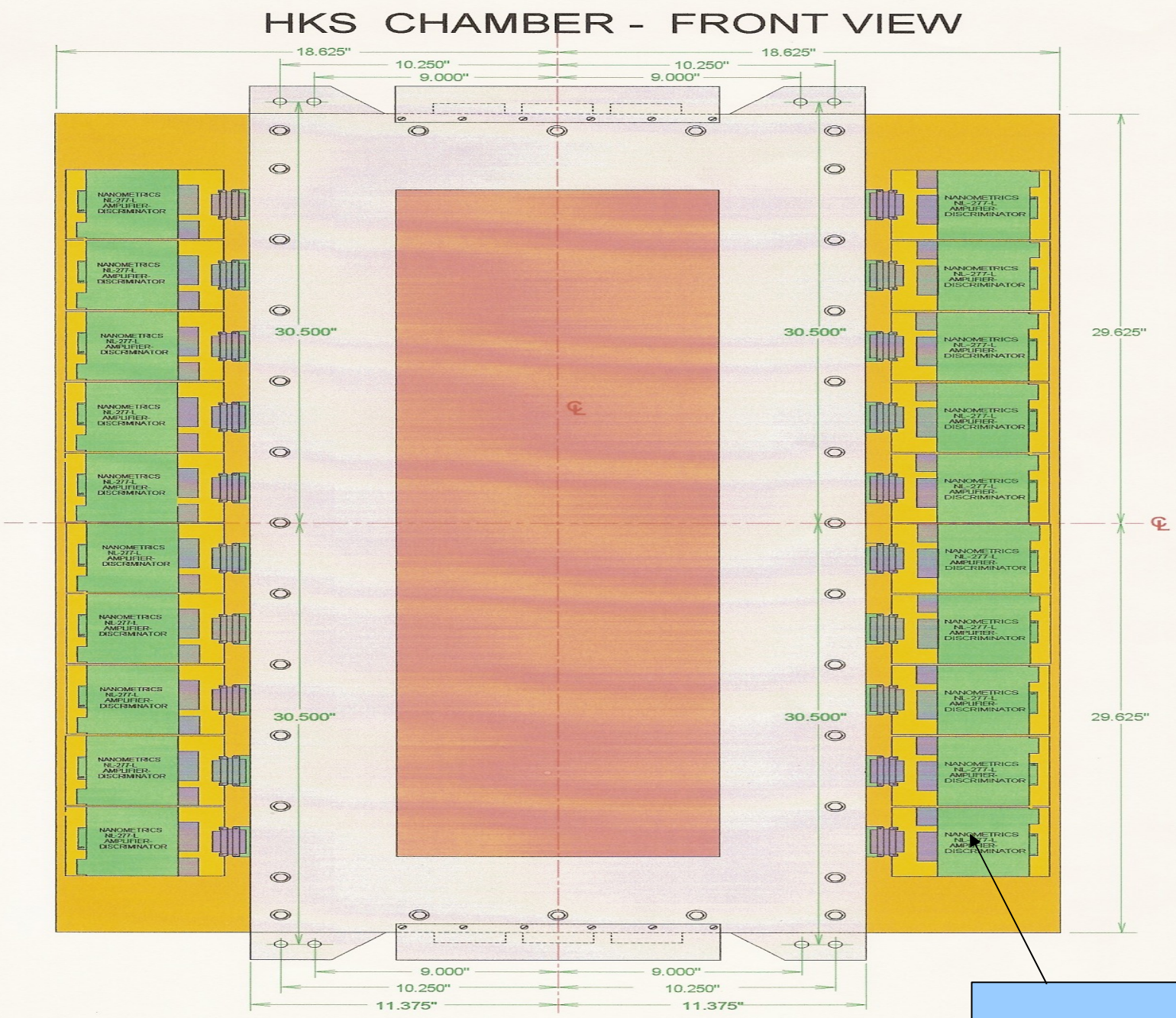
- 2 chambers with 6 planes (2-X, 2-U, 2-V). U/V at +/- 30^{o}
- 1 cm cell width.
- ~1400 channels.

- **Design based on successful SOS & HKS design and construction techniques.**
- **Individual Cathode and sense wire planes built on G10 (PCB) frames.**
- **Precision of wires is determined by PCB layout .**
- **Amplifier / Discriminator cards plug into ports on frame.**
- **Signals routed to cards via traces on PCB.**

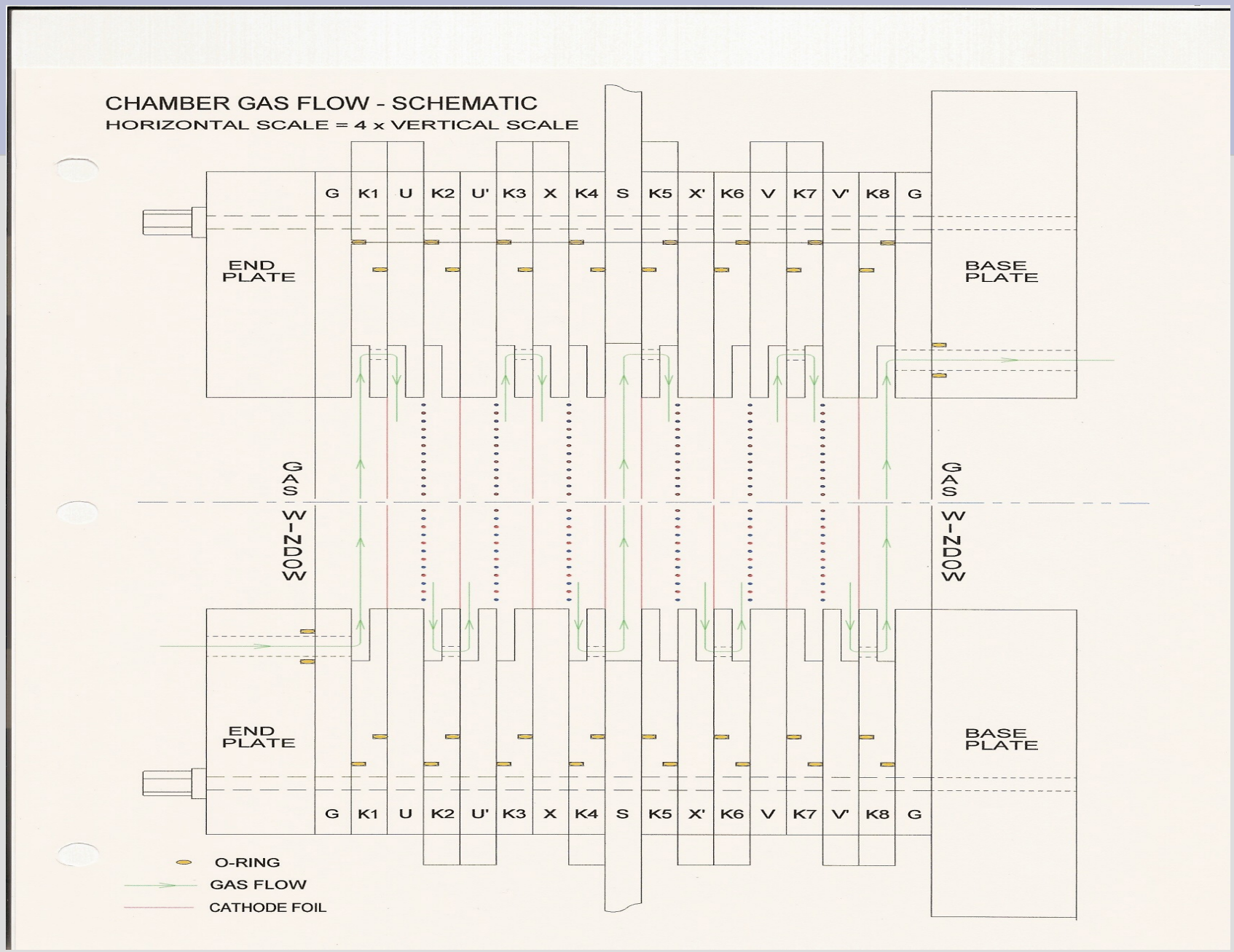
HKS Assembly Schematic



Front View

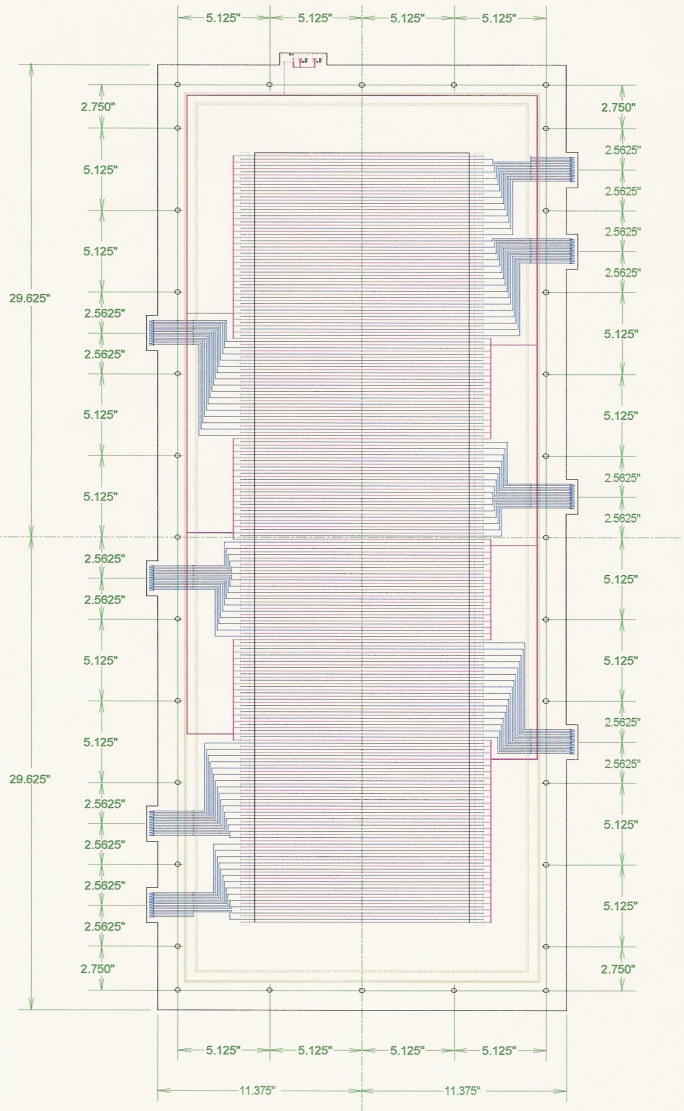

HKS CHAMBER - FRONT VIEW
18.625"
10.250"
9.000"
30.500"
29.625"
NANOMETRICS NL-277-L AMPLIFIER-DISCRIMINATOR
11.375"
Amp/Disc card

Gas Flow

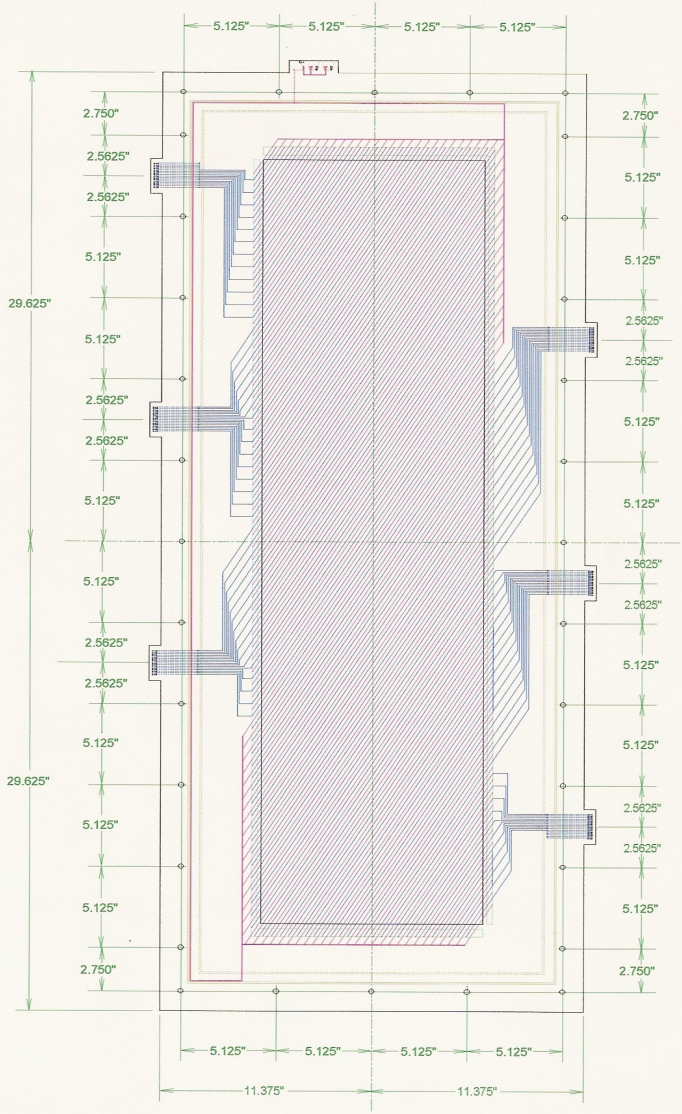

CHAMBER GAS FLOW - SCHEMATIC
HORIZONTAL SCALE = 4 x VERTICAL SCALE
G K1 U K2 U' K3 X K4 S K5 X' K6 V K7 V' K8 G
END PLATE
BASE PLATE
GAS WINDOW
GAS WINDOW
END PLATE
BASE PLATE
G K1 U K2 U' K3 X K4 S K5 X' K6 V K7 V' K8 G
O-RING
GAS FLOW
CATHODE FOIL

Composite Views

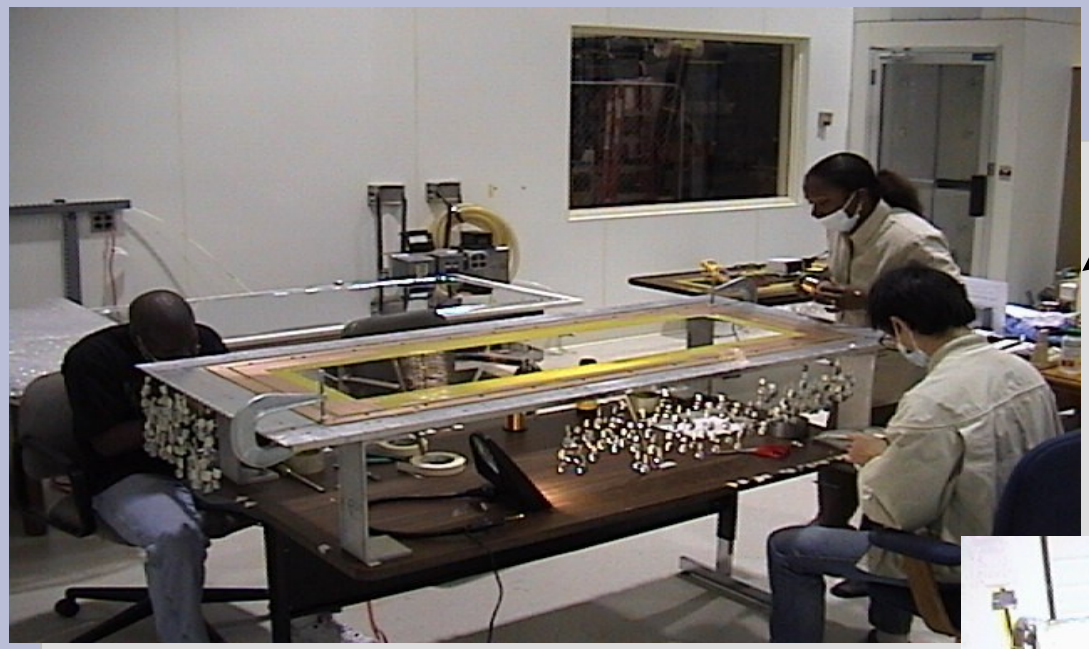
X PLANE PCB COMPOSITE VIEW



U-V PLANE PCB COMPOSITE VIEW



HKS Chamber Construction by HU Students & Postdocs



Wire Tensioning for single plane (new tensioning tables will need to constructed)

Closing chamber / installation of outer aluminized kapton window. Copper Mylar for cathode plane.

Scope

- Design and construction of two Drift Chambers for SHMS charged particle tracking (6 planes each)
- HU responsible for everything up to signal readout chain.
- Testing before installation
- Integration and testing in SHMS

MRI Scope

- **MRI funding includes:**
  - **Chamber construction materials (mechanical)**
  - **Labor costs (HU postdoc and graduate students)**
- **MRI funding does *not* include:**
  - **Gas Handling**
  - **Support**
  - **Discriminator cards through signal electronics chain.**
  - **Tensioning tables**

Working Timeline

- 1st ½ FY08 – 1st ½ FY09: Design of chamber layout including electrical and mechanical connections.
- Q1FY09 – Q2FY10: Purchase parts
- Q3FY10 – Q4FY10: Construct Chambers
- Q4FY10 – Q1FY11: Thoroughly Test Chambers with cosmic rays.
- FY13: Install Chambers in SHMS

Summary

- SHMS DC design based on successful SOS & HKS
  - Precision determined by PCB board layout
  - Long design time / short construction time
  - Shown to meet SHMS requirements
    (a) SOS chambers in operation for 10+ years with no broken wires,
    (b) HKS chambers operated at 10 Mhz incident flux).
- Design / Construction costs covered by NSF MRI.
- Design work is beginning now.
- Required infrastructure & expertise exists @ Hampton
  (Prof. Liguang Tang designed and oversaw construction of HKS chambers.